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33. LITTLE KNOWN BIODIVERSITY OF SUBTERRANEAN FRESHWATER HABITATS IN INDIA, WITH SPECIAL REFERENCE TO CRUSTACEAN FAUNA

The United Nations Convention on Biological Diversity (CBD), which came into force on December 29, 1993, has evoked a tremendous, determined response from the world's scientific community, as well as governments, to save the earth's fast-depleting biodiversity. Though the term biodiversity encompasses the total variability of life in the biosphere, it is often viewed in the restricted sense of epigean flora and fauna, both terrestrial and aquatic. Paradoxically, however, the vast and varied hypogean biodiversity has received little attention, especially in South Asia, including India. This is partly due to the widespread misconception that groundwater is azoic, except for some harmless bacteria.

Elsewhere in the world (see Botosaneanu 1986), however, the hypogean/subterranean biotope has been found to support rich faunal diversity, comprising almost all the free-living invertebrate groups and some vertebrates as well. For example, Pesce (1985), while reviewing the Italian groundwater fauna (stygofauna), met with the following significant stygobiont groups: cyclopid and harpacticoid copepods, ostracods, thermosbaenaceans, mysids, amphipods, isopods, syncarids, decapods, water mites, nematodes, gastropods, tricladid turbellarians, and amphipods. Other groups of organisms that are mostly stygoxenous or stygophilous, include Bacteria, Protozoa, Rotifera, Cladocera, Archiannelida, Oligochaeta, Gastrotricha, Bivalvia, and insect larvae. Further, the subterranean environment may reveal insights into biological adaptation and speciation (Barr 1968, Rouch 1986). Even the reconstruction of the earth's history is interpreted in terms of the occurrence of certain ancient stygofaunal elements (Schminke 1974, 1981).

In India, the faunal diversity of the subterranean freshwater biotope, i.e. Husmann's (1971) 'kernel zone' of groundwater, has received scant attention from taxonomists and systematists. Hence, this note is meant to update the poorly known Indian stygocrustacean fauna, and to underscore the need to start highly rewarding stygobiological research in the country.

Two methods were used to collect the animals from the subterranean freshwaters:

Direct filtration: Bore-well water was filtered for 3 to 4 hrs by tying a plankton net made of bolting silk (mesh size 70 µm) to the inlet delivery tube of overhead storage tanks in residential areas or by manually holding the net against water pumped from agricultural bore wells for *c.* 30 min. The filtrate was fixed in 10% formalin and preserved in 5% formalin solution.

Coring and filtration: Plastic tubes (open at both ends) 70 cm long and 4 cm wide, and/or metal corer, were employed in sandy or gravelly hyporheic zones of rivers. The cores taken from the sediment surface to a depth of 10-30 cm were pooled into a bucket and vigorously stirred with filtered habitat water. The supernatant was filtered through plankton net, and the filtrate fixed and preserved as mentioned above. Other details such as dissection, and drawing, are as given in Reddy (2001).

CHECKLIST OF THE KNOWN STYGOCRUSTACEANS IN INDIA

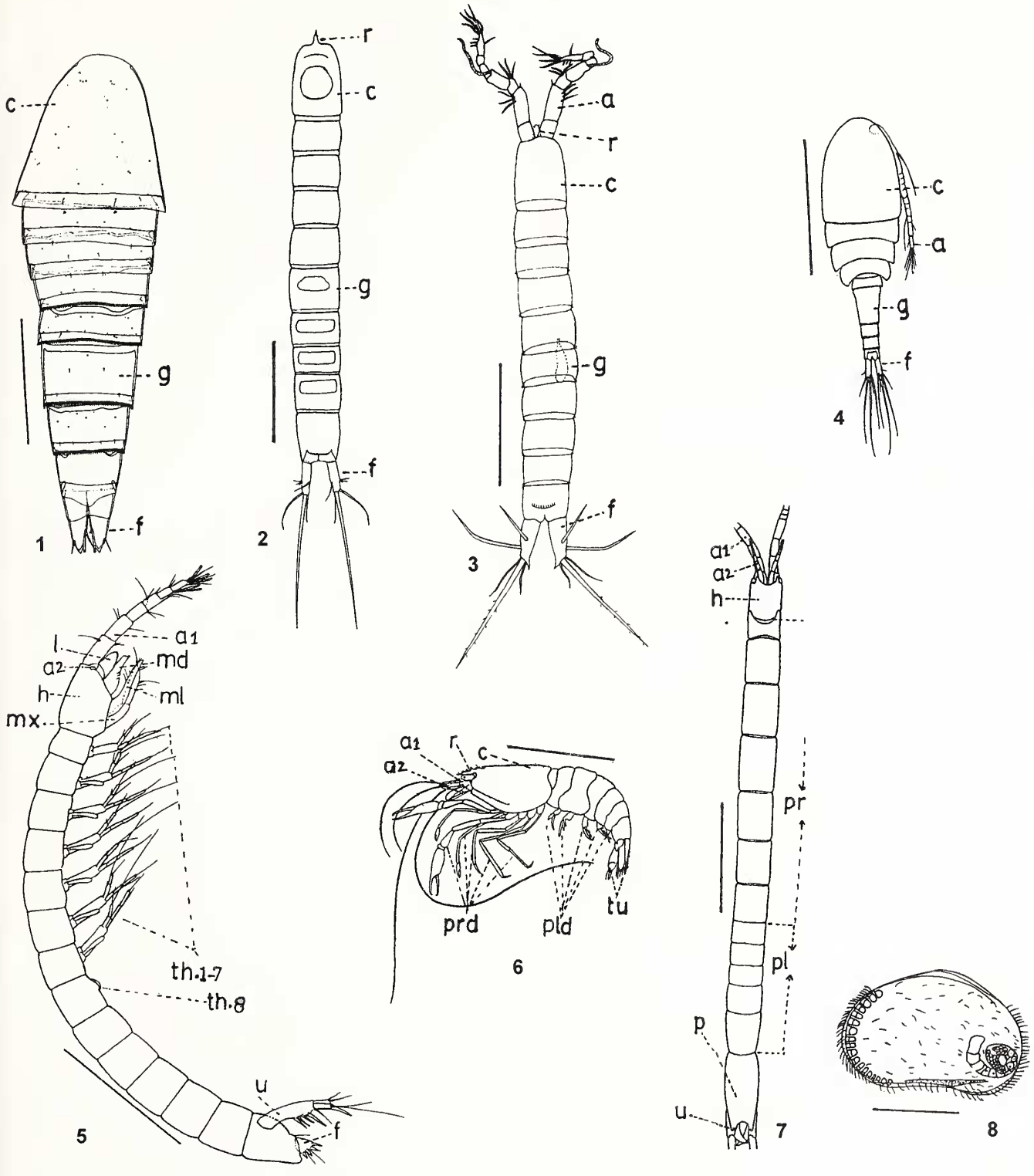
Amphipoda

Indoniphargus indicus (Chilton 1923) appears to be the first record of a true stygobiont, freshwater crustacean in India; it was found in wells, springs and mine pits in Bengal, Orissa, and Bihar (Botosaneanu 1986). No further amphipod species are known from the subterranean freshwater in India to date.

Isopoda

Nichollsia kashiense Chopra & Tiwari 1950 (Fig. 7): Wells at Benaras and Lahagara in Uttar Pradesh.

Nichollsia menoni Tiwari, 1955: Well at Monghyr in Bihar.



Figs 1-4: Some copepod representatives of the subterranean freshwater in India: 1. *Rangabradya indica*, female, dorsal, scale = 0.1 mm; 2. *Parastenocaris gayatri*, male, dorsal, scale = 0.1 mm; 3. *Leptastacus* n. sp., male, dorsal (original), scale = 0.1 mm; 4. *Thermocyclops oblongatus*, female, dorsal, scale = 0.5 mm. Abbreviations: a = antennule; c = cephalothorax; f = caudal furca; g = genital somite; r = rostrum.

Figs 5-8: Some non-copepod crustaceans of the subterranean freshwater in India: 5. *Habrobathynella schminkei*, female, lateral, scale = 0.2 mm; 6. *Troglindicus phreaticus*, male, lateral, scale = 0.5 mm; 7. *Nichollsia kashiense,* male, dorsal, scale = 5.0 mm; 8. *Cypretta fontinalis*, female, left valve, dorsal, scale = 0.3 mm. Abbreviations: al = antennule; a2 = antenna; c = cephalothorax; f = furca; h = head; l = labrum; m = mandible; ml = maxillule; mx = maxilla; p = pleotelson; pl = pleon; pr = preon; prd = pereopods; pld = pleopods; th. 1-7 = thoracopods 1-7; th. 8 = thoracopod 8; u = uropod.

Decapoda

Macrobrachium cavernicola (Kemp 1924): Streams and pools in Siju Cave, Garo Hills, and a cave near Cherrapunji, Meghalaya (Kemp 1924).

Troglindicus phreaticus Sankolli & Shenoy, 1979 (Fig. 6): Fort Well near All-weather Port, Ratnagiri, Maharashtra (Sankolli and Shenoy 1979).

Mysidacea (from Botosaneanu 1986)

Spelaeomysis longipes (Pillai and Mariamma 1963): well at Kottayam, Kerala.

Ostracoda (from Botosaneanu 1986)

Cypretta fontinalis Hartmann 1964 (Fig. 8): Well at Junagadh, Gujarat (Victor and Fernando 1978).

Copepoda

Cyclopid and harpacticoid copepods represent a very significant and highly speciose crustacean group in subterranean freshwaters as in epigean waters. During a survey of the Indian stygofauna, conducted by the Zoological Institute of the University of L'Aquila, Italy (December 1982 to January 1983), Pesce and Pace (1984) recorded for the first time four cyclopid species in freshwater wells near New Delhi: *Thermocyclops oblongatus* (G.O. Sars 1927) (Fig. 4), *Eucyclops serrulatus* (Fischer 1851), *Mesocyclops aspericornis* (Daday 1906), and *Tropocyclops prasinus* (Fischer 1860).

As for the harpacticoids, *Elaphoidella crassa* Chappuis 1954 is the first subterranean freshwater taxon in India; it was reported from Maosmae cave near Cherrapunji by Chappuis (1954). Karanovic and Pesce (2001) have described a second species, *Rangabradya indica* Karanovic and Pesce 2001 (Fig. 1), from a freshwater well at Guntur.

Bathynellacea

The order Bathynellacea, which contains primitive and very ancient freshwater syncarid crustaceans (ancestry dating back to the Carboniferous or even earlier; see Schminke 1974), has been reported by Reddy (in press, a) for the first time in South Asia. Reddy (in press, b) has also discovered a eustygobiont parabathynellid, *Habrobathynella nagarjunai* Reddy, in a well on the Nagarjuna University campus, Guntur.

Paradoxically, the vast interstitial, hyporheic zone of the Indian streams and rivers, which is but an extension of the subterranean freshwater biotope (stygobion), has remained practically unexplored till now, as confirmed by G.C. Rao (pers. comm.), a noted marine meiobenthologist in India. Reddy (2001, in press, a) has recorded in three peninsular rivers, i.e. Krishna, Godavari, and Pennar, ten harpacticoid and two bathynellacean species, seven of which are new to science:

Copepoda Harpacticoida

Parastenocaris gayatri Reddy 2001 (Fig. 2)
Parastenocaris savita Reddy 2001
Parastenocaris sandhya Reddy 2001
Parastenocaris curvispinus Enckell 1970
Parastenocaris n. sp.
Leptastacus n. sp. (Fig. 3)
Mesochra wolskii Jakubisiak 1933
Nitokra lacustris (Schmankevitsch 1875)
Cletocamptus deitersi (Richard 1897)
Onychocamptus mohammed (Blanchard & Richard 1891)

Syncarida Bathynellacea

Habrobathynella schminkei Reddy (Fig. 5)
Habrobathynella n. sp.

With its highly diversified geomorphology, hydrography, and climate, the Indian subterranean freshwater biotope is quite likely to support rich faunal diversity as elsewhere, and thus holds enormous serendipitous potential for taxonomists and systematists. (Literally, specimens of many groundwater taxa, which are not yet known to science, are being continually consumed by man through raw water, or let into the sewers.) Considering that this special habitat has already become endangered owing, *inter alia*, to overexploitation and pollution of the water table, the national funding agencies would do well to encourage scientists to unearth the stygofaunal diversity in the country and delve into its adaptational biology. Stygobiology deserves to be treated as a distinct branch of science.

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Y. RANGA REDDY
Department of Zoology,
Nagarjuna University,
Nagarjunanagar 522 510,
Andhra Pradesh, India.
yrangreddy@yahoo.com

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34. *HYPERICUM GAITII* HAINES (HYPERICACEAE), A NEW RECORD FOR SOUTHERN PENINSULAR INDIA

The genus *Hypericum* with about 400 species is cosmopolitan in distribution. 25 species of the genus have been reported from India (Sharma and Sanjappa 1993), of which 5 species are so far known to occur in southern peninsular India.

While working on the flora of Eastern Ghats, we collected an interesting species of *Hypericum* from the slopes of Galikonda hills of Visakhapatnam district, Andhra Pradesh. After critical study it was identified as *Hypericum gaitii* Haines and found to be a new record for southern peninsular India. This taxon has not been reported so far from Andhra Pradesh (Pullaiah and Chennaiah 1997). With this report, its distribution extends from east to south. A detailed description and illustration of this species is provided here.

Hypericum gaitii Haines in J. Asiat. Soc. Beng. n.s. 15: 311. 1919 & Bot. Bihar & Orissa 1: 52.1925. Saxena & Brahmam Fl. Orissa 1: 111-112. 1994. Sharma & Sanjappa Fl. India 3: 58 f. 59.1997.

Much branched glabrous shrub, 0.8-2 m tall; stem chartaceous, terete, reddish brown, internodes long, conspicuous. Leaves simple, opposite, decussate, elliptic-oblong, to oblong-lanceolate, rarely oblanceolate, 1.5-6 x 0.3-1.8 cm, glabrous, pale and black glandular beneath, apex subacute to acute, margin entire, base sub amplexicaul, midnerve and lateral nerves reddish-brown, lateral nerves 3 pairs, basal lateral nerves running towards apex, petiole 0. Flowers yellow, bisexual, 2-5 in dichotomous cymes, 2-3.5 cm across, pedicel 7-12 mm long; bracts elliptic-lanceolate, up to 11 mm long. Sepals 5, green, free, imbricate, 8-10 x 4-6 mm, ovate or ovate-lanceolate, persistent in fruit. Petals obliquely obovate, 3 x 1.7 cm, prominently veined, black-glandular punctate, distantly serrulate. Stamens numerous, combined into 5 bunches, *c.* 25 each, epipetalous; filaments linear, 5 to 1.8 cm long, anthers yellow, 1 mm long. Ovary glabrous, ellipsoid, 7 mm long, 5- to 7-locular, broadly oblong, ovules many per locule on axile placentation; styles 5, rarely 6-7, 1.2 cm long, basally connate, persistent; stigma capitate. Capsule ellipsoid or conical, dehiscing along placenta, 1.2-1.5 cm long, tipped with persistent style; seeds numerous, brown, polished, 0.1 mm long, linear to oblong, acute to subacute at both ends, scalariform reticulate.

Fl.: February-May,

Fr: April-June.

Ecology: Rare on slopes of exposed hills.